O T T A W A August 6th, 1941.

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of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1060.

Concentration of Manganese Ore from the Nabco Manganese Mining Company Limited, Elgin, Albert County, New Brunswick.

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Shipment:

Six sacks of ore, totalling 440 pounds, were received on June 17th, 1941. The sacks contained six samples of ore, taken by Dr. W. J. Wright, Provincial Geologist for the Province of New Brunswick, from the following locations:

(Shipment, cont'd) -

Sample No. 1. From the east wall of the open cut about 20 feet north of Fenton's old shaft.

Sample No. 2. From the east wall of the open cut about 75 feet north of the old shaft.

Sample No. 3. Cross section at right angles to the vein, about 6 feet of the east wall and 6 feet of the west wall at the north end of the open cut.

Sample No. 4. Grab sample from a dump containing about 100 tons.

Sample No. 5. From ore body on the face of the raise about 76 feet above level of the tunnel. Vein about 4 feet wide.

Sample No. 6. From the dump of cobbed ore.

Sampling and Analysis:

The samples, as received, were handled in the following manner on the instructions of Dr. Wright:

A. Samples Nos. 1, 2, 3 and 4 were combined and crushed to minus 7/8 inch and a head sample for analysis was cut out.

B. Sample No. 5 was crushed to minus 7/8-inch and a head sample for analysis was cut out.

C. Sample No. 6 was crushed to minus 7/8-inch and a head sample for analysis cut out.

D. Samples Nos. 1, 2, 3, 4 and 6 were combined and a head sample for analysis cut out.

The various analyses of these samples are as follows:

Product	PER CENT			
	A.(1,2,3,& 4)	B.(5)	C.(6)	D.(1,2,3,4,&6)
Manganese	22.66	42.24	48.98	27.70
Iron	1.52	0.86	0.96	1.42
Insoluble	55.72	21.31	17.53	47.52
Phosphorus	0.03	0.02	0.02	0.04
Sulphur	0.14	0.19	0.09	0.13

Characteristics of the Ore:

Twelve polished sections of the ore were made for microscopic examination. Six sections were from the composite of Samples Nos. 1 to 4 and three each, from Samples Nos. 5 and 6.

Composite of Samples Nos. 1 - 4.

Gangue forms the greater part of the six polished surfaces and consists of hard, reddish brown- to buff-coloured rock, which encloses occasional small, irregular patches of quartz. In some hand specimens the rock material appears to be brecciated fragments which are cemented with manganese oxides.

Pyrolusite, probably with some manganite, predominates in the polished sections and forms the groundmass of the metallic mineralization. Under crossed nicols it is seen to consist of a mat of tiny, interlocking crystals which have a hard, grey, isotropic or weakly anisotropic mineral ramifying through them. Etch tests indicate this mineral to be braunite rather than psilomelane, although in one section it displays signs of concentric banding typical of the latter and both minerals may be present. The pyrolusite is very finely divided in places and much of it contains numerous, small inclusions of gangue.

Sample No. 5.

The gangue varies in character and forms the minor portion of the sections as irregular grains and small patches enclosed by metallic masses. Besides a few small fragments of the hard, reddish-brown rock noted above, there are larger areas of a white material which, from its hardness and cleavage, suggests barite. Tests applied to one or two of these white patches with 1:1 hydrochloric acid showed them to carry a little finely disseminated carbonate.

(Continued on next page)

(Characteristics of the Ore, cont'd) -

As already suggested, metallic mineralization is heavier in these sections than in those of the previous samples, and is represented chiefly by manganite with a little admixed pyrolusite as fine crystalline aggregates. These contain occasional, small patches of the hard, isotropic material thought to be braunite, and numerous inclusions of gangue, ranging from coarse to fine in size.

Sample No. 6.

These sections are much the same as those of Samples Nos. 1 to 4, both as to gangue and metallic minerals. The former material is largely the same hard, reddish brown- to buff-coloured rock. One section, however, exhibits one or two small patches of the same soft, white material mentioned under Sample No. 5, but a hydrochloric acid test revealed no carbonate.

Metallic minerals are not so abundant as in Sample No. 5, but, in general, are more abundant than in Samples Nos. 1 to 4. Pyrolusite again predominates in the same modes of occurrence as in Samples Nos. 1 to 4, and with it is admixed a small amount of manganite. In a few places, evidence is visible which suggests that the former has developed at the expense of the latter.

It may be concluded from these examinations that braunite or psilomelane, or both, are probably the original minerals which, by oxidation, have been transformed into pyrolusite, perhaps by passing through the intermediate stage of manganite.

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Experimental Procedure:

Tests were conducted by gravity concentration methods, which included jigging and tabling on the composite of Samples Nos. 1, 2, 3, 4 and 6. In Test No. 1, when treating the -7/8"+½" fraction of the ore which was too large for the laboratory jig, the sink-and-float process was used to give an approximate idea of the results obtainable when using a full size jig on the material.

As it was not practical to treat the -7/8"+½" material in the laboratory jig, this fraction was crushed to minus half-inch for the remaining tests which were run on an unsized feed.

Tests Nos. 1 to 7.

In these tests the ore was separated into the following screen fractions and each fraction treated individually:

Test No. 1. - Sink-and-Float.

-7/8"+½" fraction. (38.2 per cent of total weight)

Product	Weight, per cent	Assay Mn, per cent	Distribution Mn, per cent
Concentrate	46.1	44.24	81.1
Middling -	7.0	23.70	6.6
Tailing	46.9	6.63	12.3
Head	100.0	25.22*	100.0

Test No. 2. - Jig.

-½"+3/8" fraction. (15.9 per cent of total weight)

Concentrate	35.2	29.07	38.8
Middling	32.8	36.02	45.0
Tailing	32.0	13.27	16.2
Head	100.0	26.31*	100.0

* Calculated.

(Continued on next page)

(Experimental Procedure, cont'd) -

Test No. 3. - Jig.

-3/8"+¼" fraction. (8.7 per cent of total weight)

Product	Weight, per cent	Assay Mn, per cent	Distribution Mn, per cent
Concentrate	48.9	34.76	61.7
Middling	43.7	22.75	36.2
Tailing	7.4	7.90	2.1
Head	100.0	27.57*	100.0

Test No. 4. - Jig.

-¼"+6 mesh fraction. (11.4 per cent of total weight)

Concentrate	44.2	33.81	52.1
Middling	36.0	31.92	40.1
Tailing	19.8	11.38	7.8
Head	100.0	28.70*	100.0

Test No. 5. - Jig.

-6+8 mesh fraction. (4.3 per cent of total weight)

Concentrate	39.3	49.93	63.7
Middling	21.4	34.76	24.2
Tailing	39.3	9.48	12.1
Head	100.0	30.76*	100.0

Test No. 6. - Jig.

-8+14 mesh fraction. (6.4 per cent of total weight)

Concentrate	47.9	51.19	76.0
Middling	8.7	34.76	9.6
Tailing	43.4	10.43	14.4
Head	100.0	31.54*	100.0

Test No. 7. - Wilfley Table.

-14 mesh fraction. (15.1 per cent of total weight)

Concentrate	35.6	46.45	50.4
Tailing	29.7	14.22	12.8
Slime	34.7	34.76	36.8
Head	100.0	32.87*	100.0

* Calculated.

(Experimental Procedure, cont'd) -

These tests that have been shown cannot be considered to be the best possible; however, the trend of concentration is shown. In Test No. 1 the accurate separation is, of course, due to the use of the sink-and-float procedure on the coarse fraction. The jig results on the coarse sizes did not give a high grade concentrate in Tests Nos. 2 to 4 but they showed that a low manganese tailing could be discarded, leaving a concentrate and a middling that could be further treated. In continuous operation when the circuit has been stabilized, a jig concentrate ranging from 44 to 51 per cent manganese should be obtained, depending on the degree of grinding.

Test No. 8. - Jig.

In this test the ore as crushed to minus half-inch was passed over the laboratory Harz jig. A concentrate was taken from the "Side Draw" of both compartments. The jig bed was supported on a 14-mesh screen which allowed the -14 mesh material in the feed to pass through. This fine material, which contained a certain amount of slimes, would be the feed to a concentrating table. The test results are as follows:

Test No. 8. - Jig.

Unsized feed, all minus half-inch.

Product	Weight, per cent	Assay Mn, per cent	Distribution Mn, per cent
1st compt. conc.	23.9	49.95	40.24
2nd compt. conc.	20.5	43.29	29.91
Tailings	46.2	12.32	19.19
-14 Sands	7.3	33.65	8.28
-14 Slimes	2.1	33.65	2.38
Head	100.0	29.66*	100.00

* Calculated.

(Experimental Procedure, cont'd) -

It may be seen that a single pass of this material through the two-compartment jig leaves a tailing assaying 12.32 per cent manganese which contains 19.19 per cent of the total manganese present in the ore. This leads to the two following tests:

Test No. 9.

In this test the ore at minus half-inch was fed through the two-compartment laboratory Harz jig. The product from the first compartment was called the 1st concentrate, while the product from the second compartment "middling" was combined with the products which were obtained from both compartments when the tailing from the first pass was rejigged. This rejigging of the tailings from the first pass was to get results comparable to those that would be obtained if a four-compartment jig were used. This "middling" was in turn jigged to give the 2nd concentrate and second tailing. The -14 mesh material passing through the jig bedding screen was tabled to give a concentrate and tailing. It must be pointed out that 17.51 per cent of the feed weight was -14 mesh of which 26 per cent (6.76 per cent of total feed) was table concentrate. When one considers the amount of -14 mesh material in all the concentrates produced, it will be seen that 14.5 per cent of the concentrates will be -14 mesh.

Test No. 9. - Jig.

Product	Weight, per cent	Assay Mn, per cent	Distribution Mn, per cent
1st conc.	27.03	50.84	47.97
2nd conc.	12.84	37.50	16.81
Table conc.	6.76	48.80	11.51
1st tailing	29.05	7.57	7.67
2nd tailing	13.51	15.14	7.14
Table tailing	10.81	23.60	8.90
Head	100.00	28.65Φ	100.00

Φ Calculated.

(Experimental Procedure, cont'd) -

From these test results also it is seen that the combined 1st, 2nd and table concentrates would have a grade of 46.9 per cent manganese with an indicated recovery of 76.39 per cent.

Test No. 10.

This test was similar to Test No. 9 except that the jig "middling" was crushed to minus ¼-inch before being rejigged. This raised the percentage of fines present in the total concentrate but, as the grade was considerably higher, this recrushing was justified.

Test No. 10. - Jig.

Unsized feed, all minus half-inch.

Product	Weight, per cent	Assay Mn, per cent	Distribution Mn, per cent
1st conc.	25.74	50.32	44.28
2nd conc.	10.12	50.78	17.57
Table conc.	8.71	47.71	14.20
1st tailing	34.87	8.07	9.62
2nd tailing	11.73	17.84	7.15
Table tailing	8.83	23.80	7.18
Head	100.00	29.25*	100.00

* Calculated.

From the above figures, it may be seen that of the total concentrate which has a grade of 48.73 per cent manganese, 19.6 per cent of the weight is minus 14 mesh. This, although it is a somewhat higher figure for fines than is shown in Test No. 9 due to the crushing of the middlings, is still not an excessive amount.

Summary and Conclusions:

From the sample of ore submitted for testing, it is apparent that it will be possible to produce a metallurgical grade manganese, with a recovery of approximately 75 per cent of the contained manganese. The various requirements for furnace ore will be met, we believe, as the phosphorus content of the concentrates is low and the amount of fines present not excessive. The complete analysis is as follows:

Composite of concentrates from Test No. 10.

		Per cent
Manganese	-	48.73
Phosphorus	-	0.024
Sulphur	-	0.03
Iron	-	0.85
SiO_2	-	15.19
Al_2O_3	-	1.74

Plant requirements will not be complicated or too expensive. The equipment that should be necessary will be as follows:

Crushing equipment to reduce the ore to at least minus 7/8-inch and preferably minus ½-inch before primary jigging; storage bins; ore feeders; one four-compartment Harz type rougher jig, which would produce a finished concentrate in the first compartment, a "middling" for retreatment from the 2nd, 3rd and 4th compartments and a final tailing; a two-compartment retreatment jig to produce a final concentrate from both compartments; a crusher unit to reduce the "middlings" to minus 3/8-inch before retreatment; and a Wilfley or some other type of concentrating table to handle the jig screen undersize.

It must also be pointed out that jigging and tabling require a large amount of water, the ratio being approximately 10 parts of water to every part of ore treated, so storage for water should also be provided.

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(Summary and Conclusions, cont'd) -

From our test results it appears that for each 100 tons of ore that is fed to the mill, approximately 45 tons of concentrates, with a grade of 48 to 50 per cent manganese, will be produced. However, if a lower grade of mill feed is used, this amount will be lowered somewhat.

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